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Kearney, Edward J.

Transportation--the master key to progress

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TRANSPORTATION—
THE MASTER KEY
TO PROGRESS

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By EDWARD J. KEARNEY

Delivered at Lenox, Mass., by its retiring President, before the

NATIONAL MACHINE TOOL
BUILDERS' ASSOCIATION

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Oct. 3, 1923

NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION, PROVIDENT BANK BLDG., CINCINNATI, OHIO, ON REQUEST WILL SUPPLY COPIES OF THIS ADDRESS

MACHINE tools are called, and rightly so, the "Master Tools of Industry;" but they are not a primary product, creating their own demand, or connected, except very indirectly, with individual consumption. They are the instruments necessary to the creation of machines that themselves reach the final consumer, such, for example, as carpet-sweepers, automobiles, and radio outfits, and also for the creation of machines that are many times removed from the ultimate consumer, such, for example, as the steel mills that make the rails, that carry the locomotives, that draw the cars, that deliver to the consumer the carpet-sweeper, the automobile, and the radio outfit. So it turns out that new developments to which we look to give impetus to our industry are not of our creating. When a new machine, or a more highly developed old one, presents a demand, either for greater precision of manufacture or increased production at less cost, we meet that demand and in that way make our contribution to progress.

During the last sixty years there have been many new developments that were of such magnitude and which came forward with such a rush, that they, together with production already established, created a peak demand for machine tools. Every one of these forward movements left the industry on a higher level than before. Among the developments that have given this added impetus to the industry that may be mentioned as examples are the sewing-machine, the electric generator and motor, the bicycle, and the automobile.

REACTION AFTER POST-WAR BOOM

The reaction following the artificial stimulus of the war and the post-war boom, when machine tools were in uncompromising demand, has not yet left us. Our suffering has been long and intense. The statistics which we began to gather in 1920 show that as compared with the first quarter of that year, the business of the third quarter of 1921 was only 10%, due to both reduced prices and reduced volume. The gradual improvement that has been made since shows that our factories, taken as a whole, are now working at only about one-third of their capacity. Under such conditions, it is not surprising that many of our members have been forced into receiverships, and the strongest have seen their surpluses diminish, and, in many cases, their capital impaired. There are no figures on which to base the assertion, but it is my belief that a combined financial statement of the industry made now, as compared with three years ago, would show a shrinkage or net loss of at least 25% in the total net value of the industry. When we met in annual convention three years ago, we had on our membership roll 209. Today, it is reduced to 135.

It is not known among businessmen generally that the machine tool industry suffers during the downward swing of the business cycle to a far greater extent than ordinary manufacturing lines, for the reason that our product

is bought mainly during periods of expansion. The carpet-sweeper manufacturer, when his business shrinks 5%, buys no more machine tools, so that our business, as far as he is concerned, falls 100%. The example could be extended almost indefinitely. If we were sufficiently numerous to be of importance in our national elections, attempts would long ago have been made to capitalize our distress at the polls. Is it therefore any wonder that we are asking one another whenever we get together by two's and three's, "What is the next development that will sustain the machine tool industry?" Every one has an answer. I have mine. It is general, mechanical, industrial, and agricultural development and prosperity, with TRANSPORTATION THE MASTER KEY TO PROGRESS. Unfortunately there are certain elements in our political life that would throw the key into the well and prevent entrance into that temple of well-being—"universal prosperity."

Future progress depends on adequate transportation facilities. So important is this that it should be a matter of the most serious concern of every businessman and citizen. It is this view that leads me to present an outline of the case and show where we can do something for ourselves and in the public interest.

There are few people not actively connected with railways or who have not made a study of their growth, who have any idea as to the enormous extent to which transportation in this country has grown, or to where it will lead with the present rate of growth continued. This is why we should be concerned.

PASSENGER

It seems to be a part of our national genius to travel. This is due in part to the prosperity of our people, and in part to our universal educational system which carries with it the desire to see other sections of our country and other lands. For example, the Iowa farmer, when the corn crop is good and hogs are high, spends the winter at Long Beach, California. The Colorado school teacher spends her vacation attending summer school at Columbia University. The Ohio business man goes South for a late and an early game of golf, and all of the newly-weds see Niagara.

In addition to this, the system of marketing our products has brought about extensive travel on the part of representatives of manufacturing concerns, wholesalers, and others, so that railway travel, in spite of the coming of the automobile, is growing rapidly. In 1880 the per capita travel was approximately 100 miles, which has continued to grow steadily during each decade until it is now about 400. These figures show their true comparison when it is recollected that the population of the United States in 1880 was only 50,000,000, meaning that the number of passenger miles traveled at the present time is over eight times what it was in 1880.

FREIGHT

When we come to the study of the subject of freight, we find a similar condition with the difference that the rate of increase is much more rapid. The per capita ton miles rising steadily during the period, multiplied itself about six to one. In 1880 the number of tons of freight hauled one mile was 32 billion (32,000,000,000); while it is estimated that for the year 1923 it will be beyond 415 billion (415,000,000,000), or 13 times as much.

Some investigators are of the opinion that the length of haul will diminish, owing to the tendency to establish factories in other than the strictly industrial sections and nearer to the point of consumption. This would have the effect of keeping down the ton-miles as compared with the number of cars loaded. But, on the other hand, the motor truck on hard roads is taking away many of the short hauls, tending again to lengthen the average haul. At the present time the product of the mine, the forest, and the farm furnishes 70% of all the freight, and none of these can be moved. State traffic furnishes but 15% of the whole, while interstate traffic furnishes 85%. In this discussion passenger traffic would be eliminated if it were possible, but people will and must travel, and the high speed, preference trains furnished for their accommodation clutter up the tracks, increase the time and cost of getting slower-footed freight over the road, and consequently increase the number of freight cars and locomotives necessary for a given volume.

FUTURE TRANSPORTATION REQUIREMENTS

Every factor in the economic progress of our country points to greater production, greater wealth, and higher standards of living; consequently, greater consumption, necessitating more and better transportation. There are ample grounds for the prediction that within 20 years we shall demand of the railroads the moving of twice the amount of freight carried today, or more than 800 billion ton-miles. In addition, they will be called on to provide for a 75% increase in the passenger miles traveled. Given the vitalizing power of sustained credit, without which nothing can be done, is it a task capable of accomplishment? Will it be possible in this space of time to provide facilities to dispose of this overwhelming volume? Are there any improvements in sight that, if applied, will help to a solution?

TOUR OF INSPECTION

For the purpose of bringing the answer to you, a tour of inspection was taken by me last month, railway officials and workmen interviewed, engineers connected with railway supply and manufacturing concerns questioned, and other sources of information consulted, resulting in the accumulation of data many times the amount that it is possible to present here.

RIDE ON A FULLY EQUIPPED MIKADO

One-third of the way back to the beginning of railways, your President was engaged through the greater part of seven years in supplying fuel to the small but hungry furnaces of the locomotives of that day. Since then, while he has depended for his livelihood on the design and manufacture of machine tools, interest has not been lost in the development of railway appliances and their application to the growing needs of the country. Interest in railway development has, however, not taken the form of active contact so that it will be 30 years next month since last standing on the deck of a moving locomotive. It is easy, under such circumstances, to imagine the thrill received from a ride taken a few days ago on a modern freight locomotive many times the size, and burning only about one-half the coal

per unit of useful work of its predecessors of 30 years ago. The comparison also applies to many of its contemporaries as far as fuel consumption is concerned.

LARGER LOCOMOTIVES

Throughout the years of railroad building, when attention was principally given to the extension of lines and territorial development, locomotives changed mainly in size, the general construction remaining about the same. Each decade saw larger and larger locomotives in use, but all embodying approximately the same principles and methods of steam-making and distribution as were employed in the eight-wheelers of the sixties.

SUPER-HEATING

Investigation shows that improvements have now been made greatly increasing the economy and power of the steam locomotive. This has been brought about by adding new principles, such, for example, as super-heating, which means that the temperature of the steam is raised above the temperature which it normally has when in contact with the water from which it is made, the additional heat added being entirely a gain in economy.

The increase in efficiency, due to the use of super-heating, means less fuel consumption for a given output of work, or an increased output of work with the same fuel consumption. This increase varies according to the conditions, and, at the higher speeds at which freight locomotives are operated, say from 20 to 40 miles per hour, amounts to as much as 33% increase in draw-bar pull. This improvement has been applied to about 50% of the locomotives now in use.

FEED WATER HEATERS

It may seem strange that such a simple device as a feed water heater, which has been used in stationary practice so long, has not been generally applied to locomotives. It must be remembered that the locomotive is limited to the width of the track upon which it runs, which cannot be made wider, and to the height and width of bridges and tunnels. Within this space everything that is to be attached to a locomotive must be placed, and it has taxed designers to the utmost to provide these extra devices within the limits allowed, and at the same time make them of sufficient simplicity to remain absolutely reliable in service and not too costly to maintain. Hard water may cause trouble and make the heater a nuisance. The facts are that there are comparatively few feed water heaters in use on American locomotives. As now used on some of the locomotives built within the last three years, it has the effect of adding over 15% to the draw-bar pull at speeds ranging from 20 to 40 miles per hour. This device is now applied to less than 1% of the locomotives of the country, but will become universal.

WATER RECTIFICATION

Mention has just been made of the difficulties that might be encountered in feed water heaters by the use of hard water. This is as a mere nothing to the trouble it makes inside the boiler. Hard water for steam-making purposes is not only detrimental to economy but is a positive block to regularity of service, especially in the winter, when maximum steaming is required on account of adverse track conditions.

Fortunately all water is not hard, but there are many sections where it is. In some sections where the water is not the best, it can be used by adding chemicals to prevent the forming of hard scale. With this system, frequent boiler washings are necessary. Some waters, especially in the West, are wholly unfit for steam-making purposes until after they are treated in water rectification plants. Steamships use sea water to condense the steam, which is returned to the boilers and used over and over again. Locomotives must use whatever kind of water they find at convenient points on the line. Proper treatment is vital to economy and reliability of service.

INCREASING THE HEATING SURFACE OF FIRE BOX

Thermo-syphon fire-box equipment, employed on a few locomotives, consists of large tubes which spread out into a fan-shaped structure connecting the crown sheet with the lower front part of the fire-box. Its effect is greatly to increase the circulation through and around the fire-box and over the crown sheet, the hottest part of the locomotive boiler, and therefore greatly increase steaming capacity. About 15% can be added to the draw-bar pull at normal speeds by the use of this device. This also provides a support for brick arches which are now applied to 75% of the locomotives in use.

COMBINED BENEFITS OF STEAM-MAKING DEVICES

The devices mentioned thus far are all for steam-making. By their combined use, either on new or old locomotives modernized, about 80% more volume of steam can be produced with a given size boiler with the same amount of fuel consumption, which means that a 3,000 ton train can be increased to beyond 5,000 tons on the open road and proper speed maintained.

This picture is somewhat dimmed by the fact that these devices are of little or no value in starting the train, which requires a draw-bar pull of about 18 pounds per ton, whereas only about seven pounds per ton are required to keep it rolling when once started on straight and level track. Nor are they of any special use on the grade when the speed is reduced to near the stalling point, except on locomotives especially designed for heavy grades and low speed. Such locomotives are not adapted for service on the open road where relatively high speeds must be maintained to economize time and prevent congestion.

THE BOOSTER

In order to enable the locomotive with its improved steam-making devices to get its enlarged train started and over the stalling grades, a mechanism had been applied called, in railroad parlance, a "booster." This is the newest development, and has been applied to only a comparatively few locomotives, but quite sufficient to prove its value. In order to understand better its application and usefulness, it will be necessary to consider briefly the principle of locomotive-wheel arrangement for different kinds of service.

At low speeds the greatest tractive effort is exerted, but owing to the low piston speed, less steam is needed; therefore, the switching locomotive

has a comparatively small boiler and all the weight is carried on the drivers. The same principle applies to the so-called "Mallet" type, designed for mountain grades, where double sets of drivers and cylinders are placed under one boiler. Neither of these types is suitable for high speeds, as their boilers would not furnish a sufficient supply of steam.

In heavy passenger and fast freight service, the conditions are exactly reversed. The steam requirements go up with the speed, and the tractive effort goes down; consequently, large boilers are used and the weight carried in part on truck wheels, both front and rear. The rear set of wheels are called trailers and are smaller than the drivers in order to find accommodation under the fire-box, which places a limit to the rearward extension of the drivers. When the train is being started, or running on grades or sharp curves at very low speeds, then all of the tractive effort possible is needed. Under such circumstances there is a surplus of steam. These are conditions where the booster comes in. It is a double cylinder steam engine, spur geared to the trailing wheels at a ratio of three or four to one, by means of shifting gears, which automatically disengage when not wanted, leaving the trailing wheels to run free. Its action, when engaged, is very much like an automobile running in low to pull itself out of the mud. About 25% is added to the draw-bar pull at speeds under 12 miles per hour on a locomotive with eight drivers coupled, providing that the trailers carry the same weight as each pair of driving wheels. The effect of the booster is to start a longer train with less shock due to slack taking, and take it over a steeper grade without stalling.

ELECTRIFICATION

All the world loves a contest, as the gate receipts at recent fistic encounters amply testify. That is why we are thrilled by seeing a notice in the daily press of a contest between a steam and an electric locomotive. The two were coupled together and speeded up to 60 miles an hour by the steam locomotive. The current was then turned on, the steam locomotive continuing to do its best while the electric locomotive exerted its power in the opposite direction. The two were not only brought to rest, but the steam locomotive was entirely overcome and pushed rapidly backward by its new rival.

The electrification of railways fascinates the popular mind, and for this there is ample justification.

Improvements in steam locomotive, such as we have been considering, postpone the day of its extinction into the distant future, if, in fact, it ever takes place. Both the electric and the steam locomotive are sure to have a huge part in speeding the mighty stream of traffic that flows in an ever increasing flood from state to state and onward to the sea. The use of electric locomotives will increase, for a very good and simple reason. It takes six or seven times as much draw-bar pull to take a train over a 2% grade, as it takes to move it on the level. If the train is to go through unbroken, it requires double and triple heading, pushing and double pushing. With all this extra power, the speed is reduced to a crawl, congesting the line at a point where double tracking or quadruple tracking is liable to prove difficult and expensive, as these are the points where tunnels and other obstructions are most likely to be found.

With electricity, power without limit can be concentrated, train speeds maintained, and the heavy grades cease to be a limiting factor on the line. Many other things can be said in favor of the electric locomotive, such, for example, as its ability to stay in service and make long runs. Its one drawback is cost of installation, which is many times more than is required for steam; so that at present, and perhaps for many years to come, it will best justify itself on mountain grades, tunnels, and terminals.

SIDINGS, SWITCH AND SIGNALS

Improvements in the capacity and economy of the power is of comparatively little avail unless there are also corresponding improvements in other portions of the whole mechanism of the railroad. Long, heavy trains can not be sent over single or double track lines unless sidings are supplied in sufficient quantity and size to take care of them, and provision made for their speedy operation.

Thousands of miles of railway are without block signals. These were first introduced purely as a safety device but have now become necessary for the expedition of traffic over congested lines. In the pioneer days, when trains were few and small, there was no great loss if the train came to to a full stop when taking the siding, giving the brakeman opportunity to run ahead and turn the switch, and for the train to pull into the siding and move out again after the meeting had been made, making a third stop for the brakeman to close the switch and catch the rear end of the train. But when it is a congested line with 5000 tons of freight and a modern power unit, it becomes a matter of very great importance and can only be handled to the best advantage as regards economy, expedition, and safety, by interlocking switches and signals in control of an operator near the siding or several miles from it. In other words, the time is at hand when trunk-line railways must cease hand operation and adopt machine operation for economy and quantity, sending trains from one track to another, or in and out of sidings by the push of a button in place of the slow methods of the past.

BRAKES

The layman ordinarily thinks of air brakes as something that was invented and completely perfected a half century or more ago. The service rendered to the safety of the railways throughout its life has been of the greatest value, but this has only been accomplished through continued improvement. There are new improvements made that can be applied when the proper time comes, for the further effectiveness of the service on very long trains. The brakes take effect progressively from the head to the rear end of the train. Their action is so slow, both for setting and releasing, that it is impossible to apply them on a long train of from 75 to 100 cars, without bringing it to a full stop, unless the train is running at a speed greater than ten miles per hour.

In the New York subway, ten-car passenger trains are operated at extremely short intervals, the trains being equipped with electro-pneumatic

brakes, so that the brakes are set and released simultaneously and instantly on each car as though it were a single unit by itself. Electric control of air brakes will certainly be a requirement of the future. I am aware that conditions are not ready for the general application of electro-pneumatic brakes at present, and that is why it is spoken of as a requirement of the future.

On freight cars the power of the brakes can only be adjusted to the empty car, when the car loaded may weigh three or four times as much. This means that where loaded cars and empty cars are in the same train, the braking capacity on the empties is three or four times as much as it is on the loaded cars, with consequent shock and damage creating a limiting factor on this type of service. Improved brakes have been designed and applied to a small extent to meet these conditions.

These are only a few of the outstanding improvements that are possible of being applied to the task of greater and more economic transportation.

Developments in operation will lead to the placing of Chicago, Pittsburgh, Kansas City, and other restricted gateways on stub tracks, the main line passing them by.

KEEPING THE EQUIPMENT IN SERVICE

One of the greatest economies in railway operation is to keep the equipment in use the greatest possible amount of time. In our own business we recognize the value in reduced overhead when our equipment can be used full time, or better still with more than one shift. The same is true of railway equipment. In order to bring this about, there must be facilities for taking care of locomotives at the terminals so that they will be the least possible time out of service. This means better and larger round-house facilities, sanding and coaling devices, boiler washing equipment, and last, but certainly not least, modern machine tools for both the round-house shop where temporary and emergency repairs are made, and for the general shop where thorough overhauling is done.

IS MANAGEMENT INCOMPETENT?

It has been shown that there are improvements in equipment actually tested and to a limited extent in use to warrant the conclusion that there are no engineering obstacles to more, better, and relatively cheaper transportation. Reference is frequently made in certain quarters to the incompetency of railroad management. Let us see as to that. Since taking back the roads from the government on March 1, 1920, the number of employees has been reduced by 150,000, while the amount of traffic being moved at the present moment is the largest in history, with a steadily rising car surplus for the October peak. This hardly looks like incompetence.

TAKE IT OUT OF THE RAILROADS

The only thing that stands in the way of growth of transportation facilities is lack of capital. No arguments are necessary to convince you that the capital will be forthcoming if there is prospect of security for the investment and a continued return satisfactory compared with what can be obtained in other industries. The selling methods of our political leaders have not improved as rapidly as have those of the makers of some less important commodities, with the result that the people are misinformed and led to believe false economic doctrines. When any considerable class is adversely affected, such for example, as the wheat growers or the coal consumers, what is the first suggestion for relief? Take it out of the railroads.

COMMISSION HAS DOUBLE RESPONSIBILITY

In the Transportation Act of 1920, Congress places the regulation of the railroads in the hands of the Interstate Commerce Commission with instructions to see that no injustice is done any shipper; also charges them with an equally important duty of seeing that the railroads receive a return, which will attract capital sufficient for adequate growth and development.

Mechanically the railroads are on the way to handle the ever-increasing volume of traffic and to do it so much more economically as to give promise of ultimate freight rate reductions. Our opportunity is in using our influence with those in authority to promote and maintain a government policy favorable to the development of transportation, the master key to progress. Vital to mechanical progress by the railway is the investment of vast capital. Underlying such investment is confidence in the stability of railway income. Behind this in turn is stability of government policy. Efforts are being made to repeal the Act or so to amend it that the revival of railroad credit will be impossible and public interest suffer irreparable damage. Some men in public life do not seem to know that one dry bearing will be just as disastrous to the operation of the whole machine as if no oil were used at any point. The immediate objective is a further trial of the Transportation Act without experimental amendments. In future years the objective is so to guide the progress of perfecting the law that always embedded in it will remain the principle of net income adequate for the attraction of investment capital.

Can you not picture a shrinking map with the Missouri Valley products only 48 hours from Atlantic harbors? Can you not visualize with the prosperity incident to these developments an enormous increase in the use of mechanical equipment on the farm, in the home, on the railway, in the air—wherever there are tasks for human hands to perform? Does this not mean that the manufacture of machine tools will become a more stabilized industry depending less on the activities of any one line and more on the general prosperity of all the people?

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